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Fattening costs of beef breeds reared under controlled conditions and the determination of optimum fattening period

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Abstract: The primary purpose of this study was to calculate the fattening costs of different cattle breeds reared under controlled conditions and to determine the optimal fattening period that will maximize the net profit. The data were from 21 bullocks consisting of 7 Holstein, 7 Piedmont × Holstein, and 7 Limousin × Holstein cross-breed cattle reared and fattened in the closed tie-stall experiment barns of the Aegean Agricultural Research Institute, Turkey. The data used for the analysis were from the year 1999, but were updated for 2007. The fattening period lasted 280 days, after a rearing period of 195 days. The average live weight, costs of 1 kg live weight, yield ratio, and net profit per animal at the end of fattening period were 510.86 kg, YTL 3.65, 57.36%, and YTL 462.33, respectively. The Limousin breed yielded the highest net profit. The optimal fattening period was 5 months. Net profit increased by 21.67%, while the costs of 1 kg live weight decreased by 13.97% at optimal fattening relative to the fattening period in the application. Live weight, yield ratio, meat price, gross production value, production costs, and net profit per animal differed significantly among the Holstein, Piedmont, and Limousin breeds. The results indicated clearly that the optimal fattening period (5 months) yielded much more net profit in comparison with the fattening period in the application. It appears possible to arrange different plans for different cattle breeds.

Key words: Optimum fattening period, cattle fattening meat costs, profitability

Kontrollü koşullarda yetiştirilen sığır ırklarında besi maliyetleri ve en karlı besi dönemlerinin belirlenmesi

Özet: Bu çalışmanın amacı, kontrollü koşullarda yetiştirilen bazı sığır ırklarında besi maliyetlerini ve en karlı besi süresini belirlemektir. Araştırmanın materyalini, Ege Tarımsal Araştırma Enstitüsü'ne Bağlı-Duraklı Deneme Ahırında besiyeye alınan Siyah Alaca ırkı ile Piedmont × Siyah Alaca ve Limuzin × Siyah Alaca melezlerinden 7'şer baş olmak üzere toplam 21 baş tosun oluşturmuştur. Çalışmanın verileri 1999 yılına ait olmakla birlikte, 2007 yılı fiyatları ile güncelleştirilmiştir. Besi süresi 195 günlük büyütme döneminden sonra 280 gün devam etmiştir. Besi sonunda, sığır başına düşen ortalama canlılık ağırlık, 1 kg canlı ağırlık maliyeti, randıman oranı ve net kar sırasıyla 510,86 kg, 3,65 YTL, % 57,36 ve 462,33 kg olarak hesaplanmıştır. En yüksek net karı, Limuzin ırkı vermiştir. Optimal besi süresi 5 ay olarak belirlenmiştir. Optimal besi süresinin uygulanması durumunda, net karda % 21,67 oranında bir artış ve 1 kg'lık canlılık ağırlık maliyetinde de % 13,97'lik bir azalma olmaktadır. Sığır başına karkas ağırlığı, randıman oranı, et fiyatı, brüt üretim değeri, üretim masrafları ve net kar ırklara göre istatistiksel olarak anlamlı bulunmuştur. Araştırma sonuçları optimal besi süresinin uygulanması ile birlikte uygulanan besi süresine göre daha yüksek net karın elde edileceğini göstermektedir. Irklara göre farklı besi planlarının yapılmasının mümkün olduğu görülmektedir.

Anahtar sözcükler: Optimum besi süresi, sığır besisi et maliyeti, karlılık oranı

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Introduction

The agricultural sector has been a major field involving many people throughout history. This sector includes plant and animal production as well as agribusiness industry and agricultural marketing. Recently, animal production has tended to have a structure, which represents a more capital-intensive production system than was the case in the last 2-3 decades. Cattle fattening has been a specialized sector in different regions of Turkey, although some farms are involved in cattle fattening along with dairy activities.

Cattle fattening undertakes a significant function in terms of alleviating shortage between the demand for and supply of red meat in Turkey. This function is essential, taking into account the rapid growth rate of population and high income-demand elasticity of red meat (1). There is a close relationship between balanced nutrition and safe and good quality red meat production, to which cattle fattening farms contribute considerably.

The determination of the optimal fattening period is crucial in terms of the profitability and sustainability of cattle fattening farms. The studies regarding cattle fattening costs under controlled conditions are limited in Turkey (2). Furthermore, studies relating to the comparative costs of different fattening cattle breeds seem to be absent from the literature, which increases the significance of this research.

While some of the cattle fattening studies involved whole economic analysis of farms (1,3,4), others investigated mainly the product prices and production costs of cattle fattening activities (5-10). The major subject matter of some studies was the efficiency of cattle fattening farms (11). The primary purpose of the present research was to determine the production costs and optimal fattening period of different breeds of cattle and thus to compare the costs and profits between the optimal and the actual fattening period.

Materials and methods

The animal material used in the research included 21 bullocks consisting of 7 Holstein, 7 Piedmont × Holstein, and 7 Limousin × Holstein cross-breeds

fattened in the closed tie-stall experiment barns of the Aegean Agricultural Research Institute, Turkey. The heat of 16 Holstein cattle from the herd of the Institute was synchronized and they were fertilized with Piedmont and Limousin sperm and the resultant cross male and female calves were the experiment material along with the pure breed Holstein male calves. The births were completed in August 1998. The first 6 months were anticipated as the rearing period of the calves and during this period the weight at birth and monthly live weight of all animals were recorded. The weighing was performed at the same hour of the day each month. All experiment animals were cared for and fed under the same conditions until 6 months. Calf beginning feed was used as concentrates between 0 and 3 months followed by rearing feed after 3 months. While the concentrate feed was limited to 3 kg per day, dry clover sliced thinly was fed *ad libitum* after the calf reached 1 month old. As forage feed, straw was mixed with concentrates and this mixture was fed to the animal in the morning followed by concentrates given *ad libitum*. The water was given to animals *ad libitum* after 2 weeks.

Each calf reaching the age of 6 months in all 3 experiment groups was included individually in the fattening process. The fattening period were initiated after 15 days of training. All animals were accustomed to fattening feed and the experiment materials were disinfected (drugged) against internal and external parasites in this period. At the end of the training period the initial live weight of the animals was registered after leaving them without food and water for 12 h.

The fattening period lasted 280 days, consisting of 10 periods of 4 weeks (28 days). The fattening period started after 195 days of rearing (Table 1). The animals that completed their fattening periods were weighed while they were hungry and waterless for 12 h and sent to be slaughtered. The fattening period were terminated in December 1999. The year 1999 prices were updated to 2007 prices based on data obtained from the Meat and Fish Association of Turkey. The prices related to feed and other inputs used in this study were updated taking into consideration the current market prices based on data from feed and drug store enterprises in İzmir province.

Table 1. Monthly rearing and fattening periods.

Periods	Day	Month	Order of Periods
Rearing Period	0–30	0–1	1
	30–60	1–2	2
	60–90	2–3	3
	90–120	3–4	4
	120–150	4–5	5
	150–180	5–6	6
	180–195	Preparation	7
Fattening Period	195–223	6–7	Initial Fattening = 1
	223–251	7–8	2
	251–279	8–9	3
	279–307	10–11	4
	307–335	11–12	5
	335–363	12–13	6
	363–391	13–14	7
	391–419	14–15	8
	419–447	15–16	9
	447–475	16–17	Last Fattening = 10

Monthly data (28 days) relating to animal weights and feed intake were recorded by the researchers and these data were used in the economic analysis. Variance analyses were used to compare the mean values of some variables of different cattle breeds. Carcass weight was determined by subtracting 2% loss from the live weight of the animal at the end of the fattening period.

An interest rate of 10.50%, which was applied for livestock credits extended to farmers by the Agricultural Bank in 2007, was used for half of operating capital due to spreading the variable costs over the fattening period as alternative costs (12,13). Cost of 1 kg live weight was calculated by dividing the production costs (including rearing costs) by the live weight at the end of the fattening period (14). Cost of 1 kg live weight gain was calculated by dividing the production costs (excluding rearing costs) by the live weight gain at the end of the fattening period (15).

Results

Live weight, carcass weight, yield rate, and live weight gain

Live weight, carcass weight, and yield rate per animal at the end of the fattening period were 510.86 kg, 293.02 kg, and 57.36%, respectively. While the Piedmont breed had the highest live weight, the yield rate was the lowest for this breed. Despite its low live weight, Limousin had the highest yield ratio, 62.61% (Table 2).

The means of carcass weight ($P < 0.10$), yield rate ($P < 0.05$), the prices of live weight, and carcass weight ($P < 0.05$) differed significantly among the cattle breeds, while the live weight at the end of the fattening period was not significantly different.

Feed intake

Feed intake per animal during the fattening period was 2330.6 kg, ranging from 2293.4 kg for Limousin to 2354.9 for Holstein. Cattle fattening under controlled conditions tended to be more characteristic of concentrated feed-intensive relative to forage-intensive system of farm-level fattening farms.

Production costs

Production cost per animal was YTL 1862.22 for overall cattle breeds, being the lowest for Holstein, with YTL 1867.10, and the highest for Limousin, with

Table 2. Live weight, carcass weight, yield rate, prices, and live weight gain per animal.

	Holstein	Limousin	Piedmont	Overall
Live Weight (kg)	508.71	496.43	527.43	510.86
Carcass Weight (kg)*	281.05	310.82	287.17	293.02
Yield Rate (%)**	55.25	62.61	54.45	57.36
Price of Live Weight (YTL/kg)**	4.34	5.01	4.35	4.57
Live Weight Gain	304.43	301.14	307.14	304.24
Price of Carcass Weight (YTL/kg)**	7.86	7.98	7.95	7.93

*P < 0.10, **P < 0.05, 1 US \$ = 1.20 YTL

YTL 1880.96. The variable costs made up 85.62% of total production costs. This percentage was similar among the cattle breeds, ranging from 85.47% for Limousin to 85.73% for Piedmont. The single most important cost item was feed costs, which consisted of 43.79% of total production costs, followed by rearing costs, with 29.72% (Table 3).

Rearing costs, variable costs, fixed costs, and production costs per animal (P < 0.05) were significant for the Holstein, Limousin, and Piedmont breeds.

Costs of 1 kg live weight and live weight gain

Cost of 1 kg live weight per animal for overall breeds was YTL 3.64, being the highest for Limousin,

Table 3. Production costs per animal.

	Holstein		Limousin		Piedmont		Overall	
	YTL	%	YTL	%	YTL	%	YTL	%
Rearing Costs **	548.96	29.40	545.22	29.65	565.91	30.09	553.37	29.72
Labor Costs	88.20	4.72	88.20	4.80	88.20	4.69	88.20	4.74
Feed Costs	824.38	44.15	801.84	43.61	820.22	43.61	815.48	43.79
Licking Stone Costs	8.72	0.47	8.72	0.47	8.72	0.46	8.72	0.47
Drug Costs	4.62	0.25	4.62	0.25	4.62	0.25	4.62	0.25
Electricity and Water Costs	27.00	1.45	27.00	1.47	27.00	1.44	27.00	1.45
Marketing Cost	17.50	0.94	17.50	0.95	17.50	0.93	17.50	0.94
Interest rate of Operating Capital	79.77	4.27	78.38	4.26	80.43	4.28	79.53	4.27
Total Variable Costs**	1599.13	85.65	1571.46	85.47	1612.58	85.73	1594.39	85.62
Cost of Management (3%)	47.97	2.57	47.14	2.56	48.38	2.57	47.83	2.57
Renting Costs	220.00	11.78	220.00	11.97	220.00	11.70	220.00	11.81
Total Fixed Cost**	267.98	14.35	267.14	14.53	268.38	14.27	267.83	14.38
Total Production Costs**	1867.10	100.00	1838.60	100.00	1880.96	100.00	1862.22	100.00

**P < 0.05, 1 US \$ = 1.20 YTL

with YTL 3.70, and the lowest for Piedmont, with YTL 3.57. Cost of 1 kg live weight was 3.6% higher for Limousin compared to Piedmont (Table 4). Cost of 1 kg live weight gain per animal was YTL 4.3 for overall breeds. This figure was similar among the cattle breeds, being a little higher for Holstein, with YTL 4.33, than the values of YTL 4.29 and YTL 4.28 for Limousin and Piedmont, respectively. Cost of 1 kg live weight gain of Holstein was only 1.16% higher than that of Piedmont (Table 4). The live weight gain and yield rate could be considered 2 major reasons for the differences in live weight gain costs among the breeds. Cost of 1 kg live weight and live weight gain per animal did not differ significantly among the different cattle breeds.

Gross production value, gross profit, and net profit

Gross production value per animal was YTL 2324.55 for overall cattle breeds, ranging from YTL 2210.55 for Holstein to YTL 2480.18 for Limousin (Table 4). Gross profit and net profit per animal were YTL 730.16 and YTL 462.33, respectively. Limousin had the highest both gross profit and net profit, with YTL 908.72 and YTL 641.58, respectively. The same values were the lowest for Holstein, with YTL 611.42 and YTL 343.45, respectively. Net profit of Limousin was 86.80% higher than that of Holstein. Both gross profit and net profit differed significantly ($P < 0.05$) among the fattening cattle breeds.

Optimal fattening period

To determine the optimal fattening period, which yields maximum net profit, monthly marginal revenue and marginal costs per animal during the

fattening period (10 months) were calculated (Table 5). The optimal fattening period was the fifth month, where marginal revenue equaled marginal costs (Table 5, Figure). The optimal fattening period was the fourth month for Holstein, the sixth month for Limousin, and the fifth month for Piedmont. The net profit of Holstein, Limousin, and Piedmont in the optimal fattening periods was YTL 467.6, YTL 709.1, and YTL 539.4, respectively (Table 5). In terms of net profit Limousin ranked first, followed by Piedmont and Holstein. The variance analysis showed that the mean differences of cattle breed were significant in terms of gross production value, production costs, and net profit per animal except for gross production value of the 2nd-4th months, production costs of the 6th-10th months, and net profits of the 3rd-4th months.

Production costs during the optimal fattening period

Production cost per animal during the optimal fattening period was YTL 1244.83, being the highest for Piedmont, with YTL 1266.72, and the lowest for Limousin, with YTL 1217.38. The feed costs in total production costs during the optimal fattening period (32.89%) were significantly lower than the same rate of 43.39% calculated for the fattening period, which lasted 10 months. In contrast, the rate of rearing costs increased to 44.45% from the level of 29.72% for the 10 month fattening period. As it was the case during the 10 month fattening period, Piedmont had the highest production costs during the optimal fattening period (Table 6). Rearing costs, variable costs, fixed

Table 4. Gross production value, gross profit and net profit per animal (YTL), costs of 1 kg live weight, and live weight gain (YTL).

	Holstein	Limousin	Piedmont	Overall
Gross Production Value *	2210.55	2480.18	2282.91	2324.55
Gross Profit**	611.42	908.72	670.33	730.16
Net Profit**	343.45	641.58	401.95	462.33
Costs of 1 kg Live Weight	3.67	3.70	3.57	3.65
Costs of 1 kg Live Weight Gain	4.33	4.29	4.28	4.30

* $P < 0.10$ ** $P < 0.05$, 1 US \$ = 1.20 YTL

Table 5. Monthly production value, production costs, and net profit per animal (YTL).

Month	Holstein			Limousin			Piedmont			Overall		
	GPV	PC	NP	GPV	PC	NP	GPV	PC	NP	GPV	PC	NP
1	993.9	727.3	266.6	1133.6	723.5	410.0	1092.8	751.3	341.5	*1073.4	**734.0	*339.4
2	1177.7	846.5	331.2	1317.2	840.0	477.2	1286.0	875.2	410.8	1260.3	**853.9	*406.4
3	1389.7	974.2	415.4	1524.6	961.4	563.2	1461.0	1002.8	458.2	1458.4	**979.5	478.9
4	1585.2	1117.6	467.6	1720.3	1094.8	625.5	1652.6	1137.8	514.8	1652.7	**1116.7	536.0
5	1692.2	1250.4	441.8	1923.4	1217.4	706.0	1806.1	1266.7	539.4	*1807.2	**1244.8	**562.4
6	1754.1	1372.0	382.1	2053.1	1344.0	709.1	1890.6	1386.2	504.4	**1899.3	1367.4	**531.8
7	1837.6	1490.8	346.8	2170.1	1473.0	697.1	1974.8	1504.1	470.7	**1994.2	1489.3	**504.9
8	1978.5	1616.0	362.6	2272.8	1595.0	677.8	2044.1	1630.1	414.0	**2098.5	1613.7	**484.8
9	2109.0	1741.1	367.9	2421.4	1714.4	707.0	2150.9	1755.1	395.7	**2227.1	1736.9	**490.2
10	2210.6	1867.1	343.5	2480.2	1838.6	641.6	2282.9	1881.0	402.0	*2324.5	1862.2	**462.3

GPV: Gross Production Value PC: Production Costs NP: Net Profit
 *P < 0.10 **P < 0.05, 1 US \$ = 1.20 YTL

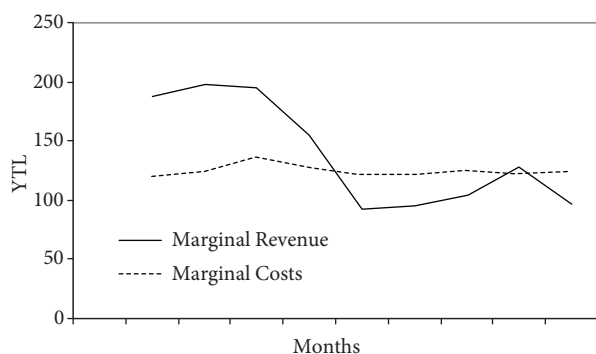


Figure. Monthly marginal revenue and marginal cost per animal (1 US \$ = 1.20 YTL).

costs, and production costs per animal (P < 0.05) differed significantly among the cattle breeds.

Costs of 1 kg live weight and live weight gain during the optimal fattening period

Cost of 1 kg live weight was YTL 3.14 during the optimal fattening period, which was 13.97% lower than the corresponding figure for the 10 month fattening period. This figure was the highest for Holstein, with YTL 3.21, and the lowest for Piedmont, with YTL 3.04. Cost of 1 kg live weight gain was YTL 7.130 in the first month of fattening. This value decreased until the fourth month of

fattening, where it was the lowest, with YTL 3.620. From this point the cost of 1 kg live weight gain increased at a decreasing rate until the end of the fattening period. Cost of 1 kg live weight gain was the lowest for Holstein at 4 months, and for Limousin and Piedmont at 5 months with YTL 3.564 and YTL 3.570, respectively. Cost of 1 kg live weight gain during the optimal fattening period was YTL 3.64, which was 15.35% lower than the corresponding value for the fattening period of 10 months. Cost of 1 kg live weight gain did not differ significantly among the cattle breeds.

Gross production value, gross profit, and net profit during the optimal fattening period

During the optimal fattening period (5 months) live weight and gross production values for overall cattle breeds were 396.76 kg and YTL 1807.23, respectively. While Piedmont had the highest live weight with 416.57 kg, gross production value of Limousin was the highest, with YTL 1923.38 (Table 7). Gross profit and net profit were YTL 705.45 and YTL 562.40 during the optimal fattening period, respectively. Net profit of the optimal fattening period was 21.64% higher than the same value for the fattening period that lasted 10 months (Table 7).

Table 6. Production costs per animal at the optimal fattening period.

	Holstein		Limousin		Piedmont		Overall	
	YTL	%	YTL	%	YTL	%	YTL	%
Rearing Costs **	548.96	43.90	545.22	44.79	565.91	44.68	553.37	44.45
Labor Costs	44.10	3.53	44.10	3.62	44.10	3.48	44.10	3.54
Feed Costs	418.90	33.50	392.19	32.22	417.02	32.92	409.37	32.89
Licking Stone Costs	4.36	0.35	4.36	0.36	4.36	0.34	4.36	0.35
Drug Costs	4.62	0.37	4.62	0.38	4.62	0.36	4.62	0.37
Electricity and Water Costs	13.50	1.08	13.50	1.11	13.50	1.07	13.50	1.08
Marketing Cost	17.50	1.40	17.50	1.44	17.50	1.38	17.50	1.41
Interest rate of Operating Capital	55.23	4.42	53.63	4.41	56.02	4.42	54.96	4.41
Total Variable Costs**	1107.18	88.55	1075.12	88.31	1123.03	88.66	1101.78	88.51
Cost of Management (3%)	33.22	2.66	32.25	2.65	33.69	2.66	33.05	2.66
Renting Costs	110.00	8.80	110.00	9.04	110.00	8.68	110.00	8.84
Total Fixed Cost**	143.22	11.45	142.25	11.69	143.69	11.34	143.05	11.49
Total Production Costs**	1250.39	100.00	1217.38	100.00	1266.72	100.00	1244.83	100.00

*P < 0.10, **P < 0.05, 1 US \$ = 1.20 YTL

Table 7. Gross production value, gross profit and net profit per animal at optimal fattening period.

	Holstein	Limousin	Piedmont	Overall
Live Weight (Kg)	389.86	383.86	416.57	396.76
Gross Production Value (YTL)	1692.23	1923.38	1806.08	1807.23
Gross Profit (YTL)**	585.05	848.26	683.05	705.45
Net Profit (YTL)	441.84	706.00	539.36	562.40

**P < 0.05 (1 US \$ = 1.20 YTL)

Discussion

Determination of the optimal fattening period that will maximize the net profit is a critic and strategic decision for ranch operators. The optimal fattening period was determined through the data recorded regularly and systematically under controlled conditions. The optimal fattening period was reached during the 5th month of fattening where marginal revenue equaled marginal costs (2,3). In terms of 1 kg live weight and live weight gain costs as

well as gross profit and net profit, great economic advantages are apparent during the optimal fattening period relative to the fattening period that lasted 10 months.

Feed intake per animal of the different breeds did not differ significantly. The concentrate feed consisted of 88.0% of total feed intake. This figure was not in line with the corresponding rate of 36.8% reported for cattle fattening farms of Eastern Anatolia in Turkey (1,4).

The percentage of labor costs in total production costs was 4.74%, which is low compared to farm-level fattening activities (1) because of automation used in the barn at the research site. The percentage of drugs costs in total production costs remained at 0.25% due to an efficient care and nutrition program applied under controlled conditions (6).

In the fattening activity that is performed in the western part of Turkey, partly based on pasture, the cost of a 1 kg increase in live weight was calculated as 1.5 YTL in 1999 (1). Another study reported that the cost of a 1 kg live weight increase was 4.18 YTL/kg, which is similar to our cost, 4.30 YTL (7).

Net profit increased by 21.64% while 1 kg live weight costs and 1 kg live weight gain costs decreased by 13.97% and 15.35%, respectively, during the optimal fattening period against the 10 month fattening period. During the optimal fattening period (5 months) Limousin had the highest net profit, followed by Piedmont and Holstein. While the net profits of Holstein and Piedmont were highest at the fifth month, this figure was highest at the sixth month for Limousin. Yield ratio and 1 kg live weight gain differed significantly among the cattle breeds. In terms of economic benefits we recommend strongly that cattle with high yield rates be preferred and the duration of the fattening period should not exceed 5 months. The study puts forth that the use of meat cattle in the fattening activity is more advantageous (5,9).

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